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SOLAR OBSERVATIONS

CORRECTIONS TO TRANSMISSION COEFFICIENTS OF SCHOTT-GLASS FILTERS

By HERBERT H. KIMBALL, Research Assistant, Harvard University

The transmission of the glass filters used in connection with determinations of atmospheric turbidity and water-vapor content have been a problem of considerable importance. Both Fuessner and Ångström warned that different samples of these screens would probably have different transmission coefficients, principally because of the fact that they do not all cut off the spectrum at exactly the same wave length.

Investigations in the United States, especially by the National Bureau of Standards, led to the conclusion that a temperature correction should be applied to the transmission coefficients. In the heading of table 3 the corrections for the transmissions of the screens are always followed by +C. The transmissions that have been used for different temperatures of the screens are given in the first column of the following table; and new determinations for each screen are given in the second column. The new values were determined from very excellent curves obtained by the Colorimetry Section, National Bureau of Standards, with a recording spectrophotometer; it is hoped the National Bureau of Standards will publish these curves.

The determination of the new temperature coefficients was not completed in time to determine the turbidities and water-vapor contents of the atmosphere from the radiation measurements obtained at Blue Hill during March 1937. In their determination from the old transmissions, a persistent difference in the results from the two screens appeared, that required an investigation. These data, as determined by means of the new transmission factors, will be published in the April REVIEW.

Transmission coefficients of Schott-glass screens at different temperatures

Temper- ature °C.	Transmission			
	OG ₁	RG ₂		
+15	0.852	0.890	0.841	0.878
20	.851	.889	.840	.878
25	.850	.888	.839	.877
30	.849	.887	.838	.877
35	.848	.886	.837	.876
40	.847	.885	.836	.876

SOLAR RADIATION OBSERVATIONS DURING MARCH 1937

By IRVING F. HAND, Assistant in Solar Radiation Investigations

For a description of instruments employed and their exposures, the reader is referred to the January 1935 REVIEW, page 24.

Table 1 shows that solar radiation intensities averaged above normal for March at all four stations.

Table 2 shows a deficiency in the amount of total solar and sky radiation received on a horizontal surface at Lincoln, Fresno, Twin Falls, Miami, and Riverside. All other stations received more than normal radiation during the month.

Table 3 shows comparatively low values of water-vapor on the 4 days during which turbidity measurements were made.

Polarization observations taken at Washington on 6 days give a mean of 56 percent with a maximum of 62 percent on the 17th. Both of these values are close to the corresponding normals for the month. No polarization measurements were made at Madison during March.

TABLE 1.—*Solar radiation intensities during March 1937*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	Sun's zenith distance										
	8 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass								Local mean solar time	
e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e	
Mar. 1.....	mm	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm	
Mar. 2.....	2.86	0.91	1.18	1.48	1.18	0.91	1.01	0.86	0.74	1.60	
Mar. 2.....	2.74	0.79	1.04	1.22	1.44					2.62	
Mar. 3.....	3.63		.84							3.15	
Mar. 4.....	4.37		.89	1.18	1.58					4.57	
Mar. 10.....	1.78		.98	1.29						1.52	
Mar. 16.....	2.62		.89	1.06						2.36	
Mar. 17.....	2.74			1.20	1.64	1.23	1.02	.92	.79	2.36	
Means.....		(.79)	.93	1.16	1.54	(1.20)	(1.02)	(.89)	(.76)		
Departures..		-.02	-.01	+.01	+.11	+.06	+.08	+.10	+.06		

MADISON, WIS.

Mar. 2.....	3.15	0.79	0.98	1.13	1.36					3.30	
Mar. 16.....	2.49	.86	1.00	1.17	1.34	1.66				2.36	
Mar. 18.....	3.81			1.27	1.67	1.31				3.15	
Mar. 19.....	2.87	.89	1.00	1.12	1.27	1.66				3.45	
Mar. 25.....	1.24									1.24	
Mar. 26.....	.98	.97	1.06	1.23	1.39	1.61	1.30			1.32	
Mar. 29.....	2.36	.86	.98	1.15	1.33	1.61	1.41			1.88	
Means.....		.87	1.00	1.16	1.33	1.64	1.34				
Departures..		-.04	-.02	.00	+.02	+.05	+.05				

LINCOLN, NEBR.

Mar. 1.....	2.62		0.86	0.96	1.41		1.49	1.33	1.20	1.00	3.15
Mar. 5.....	4.57		.96	1.18	1.36	1.70	1.39	1.24	1.13		4.95
Mar. 8.....	3.63		1.19	1.30							3.15
Mar. 11.....	2.87				1.61	1.38	1.17	1.01	.87		3.45
Mar. 15.....	1.60		.92	1.11	1.34	1.63	1.32	1.10	.95		1.45

TABLE 1.—*Solar radiation intensities during March 1937—Con.*

[Gram-calories per minute per square centimeter of normal surface]

LINCOLN, NEBR.—Continued

Date	Sun's zenith distance										
	8 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass								Local mean solar time	
e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e	
Mar. 18.....	mm	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm	2.87
Mar. 20.....	3.30										4.37
Means Departures..											

BLUE HILL, MASS.

Mar. 1.....	1.5						1.40	1.42	1.23	0.99	0.89		1.4
Mar. 2.....	2.6						0.79	0.94	1.05	1.14			3.2
Mar. 3.....	1.9						1.18	1.35	1.52	1.31	1.20	1.12	1.8
Mar. 7.....	.8	1.10	1.21	1.33	1.45	1.61	1.44	1.32	1.32	1.22	1.12		.8
Mar. 10.....	1.1						1.32	1.44	1.27	1.27			.9
Mar. 11.....	1.5						.84	.96	1.08	1.26			1.4
Mar. 12.....	1.9									1.40	1.09	.96	.85
Mar. 18.....	3.0									1.21			2.3
Mar. 19.....	4.4									1.24	1.03		
Mar. 20.....	3.5						.85	.95	1.05	1.16			3.2
Mar. 22.....	2.9						1.09	1.28	1.51	1.32	1.12	.94	.72
Mar. 23.....	2.2									1.26	1.43	1.34	
Mar. 24.....	2.8						1.10	1.27	1.43	1.30	1.18		2.1
Mar. 26.....	2.0									1.21	1.39		
Mar. 27.....	2.5									1.30	1.41		2.5
Mar. 28.....	2.1									1.41	1.30	1.18	1.06
Mar. 29.....	3.0									1.50	1.31	1.12	.98
Mar. 30.....	2.2						1.00	1.16	1.32	1.32	1.16	1.00	.87
Mar. 31.....	1.8									1.43	1.20		
Means Departures..		(1.10)	.94	1.11	1.26	1.39	1.27	1.14	1.01	.90			

* Extrapolated.

TABLE 2.—*Average daily totals of solar radiation (direct + diffuse) received on a horizontal surface*

Week beginning	Gram-calories per square centimeter															
	Washington	Madison	Lincoln	Chicago	New York	Fresno	Fairbanks	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	San Juan	Friday Harbor	Ithaca
	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	
Feb. 26.....	326	198	202	188	315	433	145	302	473	383	278	450	364	628	340	285
Mar. 5.....	368	328	426	207	218	413	156	392	403	305	360	275	521	267	224	
Mar. 12.....	270	405	291	262	212	369	216	281	384	430	381	321	514	256	223	
Mar. 19.....	286	324	261	218	328	365	219	332	516	431	319	419	360	567	275	248
Mar. 26.....	459	458	315	318	497	495	312	365	503	390	334	500	513	539		345
Departures from weekly normals																
Feb. 26.....	+36	-79	-48	-19	+67	+34	-2	-4	-	+16	-1	+42	+56	-	+58	+52
Mar. 5.....	+56	+28	+69	-3	-41	+10	+3	+48	-	-61	+64	+13	-55	-	-2	-4
Mar. 12.....	-53	+88	-82	+43	-55	-39	+19	-72	-	+8	+49	-83	-82	-	+64	-19
Mar. 19.....	-45	+6	-127	-22	+39	-87	+39	-52	-	-50	-38	-79	+4	-	+21	-39
Mar. 26.....	+108	+103	-87	+72	+212	+11	+27	+24	-	-67	+30	-71	+125	-	-	+45
Accumulated departures on Apr. 1																
	-2,625	+728	-1,631	+903	+1,701	+651	+413	-665	-	-2,016	+1127	-1,687	-1,988	-	+1,869	+1,372

ON THE METHOD EMPLOYED FOR COMPUTING β AND W , SEE P. 61 OF THE FEBRUARY 1937 REVIEW.—ED.TABLE 3.—Total, I_m , and screened, I_s , solar radiation intensity measurements, obtained during March 1937 and determinations of the atmospheric turbidity factor, β , and water-vapor content, w = depth in millimeters, if precipitated

AMERICAN UNIVERSITY, WASHINGTON, D. C.

Date and hour angle	Solar altitude	Air mass	I_m	I_s	I_r	$\frac{(*)}{I_s}$.851+C	$\frac{(*)}{I_r}$.840+C	β mean $I_m - I_r$ and $I_s - I_r$	$\frac{(*)}{I_w = 0}$ 1.94		$\frac{(*)}{I_w = 0 - I_m}$ 1.94		w	Air-mass type
									Percentage of solar constant					
Mar. 1:														
0:53 p. m.	°	'	m	gr. cal.	gr. cal.	gr. cal.	gr. cal.	gr. cal.	73.7	7.3	mm	3.4	Pc.	
0:57 p. m.	42	23	1.48	1,312	0.920	0.754	1.070	0.876	73.4	7.3		3.4		
Mar. 16:														
3:06 a. m.	42	18	1.48	1,306	.921	.755	1.071	.877						
3:02 a. m.														
Mar. 17:														
3:17 a. m.	30	46	1.95	1,095	.849	.703	.995	.824	.128	61.6	5.7	1.8	Pc.	
3:13 a. m.	31	36	1.90	1,124	.850	.704	.996	.825	.138	61.4	4.1	1.1		
Mar. 19:														
2:50 a. m.	29	48	2.01	1,184	.882	.697	1.045	.824	.076	68.0	7.0	2.6	Pc.	
2:46 a. m.	29	19	2.04	1,193	.883	.698	1.046	.825	.070	69.4	8.0	3.4		
Mar. 19:														
2:50 a. m.	34	38	1.76	1,107	.836	.677	.989	.800	.068	65.6	8.6	4.4	Np.	
2:46 a. m.	26	07	1.69	1,104	.828	.679	.992	.802	.070	65.4	8.5	4.4		

* Values reduced to mean solar distance.

Atmospheric conditions during turbidity measurements

Mar. 1. Temperature 8° C., wind, NW 13; polarization, 57.4 percent; visibility, 20 miles; blueness of sky, 5.

Mar. 16. Temperature 2° C., wind, NW 27; polarization, 51.6 percent; visibility, 12 miles; blueness of sky, 4.

Mar. 17. Temperature 5° C., wind, NW 26; polarization, 62.3 percent; visibility, 50 miles; blueness of sky, 6.

Mar. 19. Temperature 8° C., wind, NW 23; polarization, 48.9 percent; visibility, 5 miles; blueness of sky, 3.

POSITIONS AND AREAS OF SUN SPOTS

POSITIONS AND AREAS OF SUN SPOTS—Continued

Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.), Superintendent U. S. Naval Observatory. Data furnished by the U. S. Naval Observatory in cooperation with Harvard and Mount Wilson Observatories. The difference in longitude is measured from the central meridian, positive west. The north latitude is positive. Areas are corrected for foreshortening and are expressed in millionths of the sun's visible hemisphere. The total area for each day includes spots and groups]

Date	Eastern standard time	Heliographic			Area		Total area for each day	Observatory
		Diff. in longitude	Longitude	Latitude	Spot	Group		
1937	Feb. 1	h m	°	°	°			
	13 16	-54.0	120.0	+19.0	73			
		-47.5	126.5	-16.0		61		
		-41.0	133.0	+24.0		121		
		-37.5	138.5	+26.0		97		
		-28.0	146.0	+34.0	48			
		-21.0	153.0	-20.0		121		
		+13.0	187.0	+17.5	24			
		+16.5	190.5	-21.5		291		
		+18.0	192.0	+7.5	61			
		+23.0	197.0	-11.0		2,424		
		+27.0	201.0	+25.5	97			
		+31.0	205.0	+18.5		291		
		+47.0	221.0	+22.0		242		
		+50.5	224.5	-20.5	85		4,036	
	Feb. 2	11 32	-41.0	120.8	+19.5	97		
		-34.0	127.8	-15.5		73		
		-30.0	131.8	+24.0		145		
		-25.0	136.8	+26.5		97		
		-18.5	146.3	+34.0	48			
		-9.0	152.8	-19.0		218		
		+1.0	162.8	-31.5	61			
		+16.0	177.8	-14.5		121		
		+29.0	190.8	-21.5		339		
		+30.0	191.8	+8.0	61			
		+36.0	197.8	-10.5		2,182		
		+40.0	201.8	+25.0	97			
		+46.0	207.8	+18.5		242		
		+59.5	221.3	+23.0		242		
		+63.0	224.8	-20.5	97		4,120	
	Feb. 3	11 11	-72.0	76.8	-11.0			
		-69.0	79.8	+18.5	145			
		-29.5	119.3	+19.0	73			
		-21.0	127.8	-16.0		48		
		-18.0	130.8	+23.0		97		
		-11.0	137.8	+26.0		73		
		-4.0	144.8	+33.0	24			
		+4.5	153.3	-19.0		267		
		+15.0	163.8	-32.5	48			
		+30.0	178.8	-15.0		48		
		+41.0	189.8	-23.0		291		
		+43.0	191.8	+7.0	61			
		+49.0	197.8	-10.5		1,842		
		+51.0	199.8	+24.5	48			
		+60.0	208.8	+18.0	194			
		+69.0	217.8	+24.0	97			
		+78.0	226.8	+22.0	145			
		+78.0	226.8	-21.0	97		3,768	

Date	Eastern standard time	Heliographic			Area		Total area for each day	Observatory
		Diff. in longitude	Longitude	Latitude	Spot	Group		
1937	Feb. 4	h m	°	°	°			
	11 15	-70.0	65.6	-22.0				
		-58.0	77.6	-10.0			131	
		-55.0	80.6	+20.0			89	
		-18.0	117.6	+19.5			78	
		-8.0	127.6	-16.0			68	
		-5.0	130.6	+23.0			49	
		+2.0	137.6	+28.0			119	
		+9.0	144.6	+32.0			15	
		+18.0	153.6	-18.0			271	
		+26.0	161.6	-32.0			43	
		+42.0	177.6	-15.0			19	
		+50.0	185.6	+10.0			6	
		+53.0	188.6	-22.0			311	
		+56.0	191.6	+8.0			78	
		+61.0	196.6	-9.0			1,582	
		+66.0	201.6	+24.0	46			
		+72.0	207.6	+18.0	155			
		-57.0	65.4	-22.0			3,071	
		-50.0	72.4	+18.0			194	
		-46.5	75.9	-11.0			48	
		-41.5	80.9	+18.0			48	
		-40.5	81.9	-11.0	61			
		-3.0	119.4	+19.0				
		+5.0	127.4	-17.0			48	
		+9.0	131.4	+23.5			97	
		+13.0	135.4	+26.5	24			
		+21.0	143.4	+30.0	12			
		+30.5	152.9	-19.0			145	
		+40.0	162.4	-26.0			12	
		+56.0	178.4	-15.0			36	
		+60.0	182.4	-30.0			48	
		+66.0	188.4	-23.0			455	
		+69.0	191.4	+10.0	73			
		+76.0	198.4	-10.5			1,000	
		-43.0	66.3	-21.5			2,981	
		-39.0	70.3	+19.0	48			
		-28.5	80.8	+19.0			73	
		-28.0	81.3	-11.0				
		-9.5	118.8	+19.0	48			
		+21.0	130.3	+22.0			97	
		+44.0	153.3	-19.0			97	
		+53.0	162.3	-26.0			85	
		+70.0	179.3	-15.0	24			
		+73.0	182.3	-30.5			109	
		+80.0	189.3	-23.0	412			
		+87.0	196.3	-10.5	145			
		-70.0	25.9	-4.0	32			
		-27.0	68.9	-21.0			44	
		-19.0	76.9	+19.0			32	
		-14.0	81.9	-10.0	21			
		+23.0	118.9	+20.0	16			
		+35.0	130.9	+23.0	24			
		+55.0	150.9	-18.0			47	
		+62.0	157.9	-25.0	37			253